STRATEGY RESEARCH PROJECT

CONTROLLING MILITARILY SIGNIFICANT EMERGING TECHNOLOGIES

BY

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ABSTRACT

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For years, the defense industry had been the catalyst for developing emerging technologies of military importance that were subsequently found to have significant commercial application. This is no longer the case today, and we are ever more dependent on partnering with private industry to develop the technologies that will provide us qualitative superiority on the future battlefield. But how do we control technology developed in consortium with private industry in a globally competitive marketplace? This paper will discuss the defense strategy of partnering with commercial industry, emerging technologies critical to the actualization of Army-After-Next, and adequacy of our strategic export control policies. In conclusion, I will recommend changes to our strategic export control policies in order to minimize proliferation of these technologies.

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CONTROLLING MILITARILY SIGNIFICANT EMERGING TECHNOLOGIES

Defense research and development resources have been significantly reduced over the last ten years. This is due primarily to the termination of the Cold War, and has a significant impact on how America will continue to develop "leap-ahead technology" to ensure our qualitatively superior weapon systems for the future battlefield. The "peace dividend" has resulted in Army expenditures in the area of research and development being reduced to less than 1% of what commercial industry is expending.[1]

The Under Secretary of Defense, Acquisition and Technology, developed a strategy in 1995 that would leverage industrial and military capabilities by sharing research and development costs, facilities and intellect. This strategy, focusing on dual-use technology, was a direct result of recognizing that while the military's ability to influence commercial interest in weapon systems development was diminishing, technologies that could be of use to both the military and private industry are evolving.

Of significant concern is what strategy is in place for "protecting" the U.S. military once these technologies are developed. If they are of such critical importance to the U.S. military in its ability to maintain its technological edge on the battlefield, what can or should be done to ensure they are

not improperly diverted (or converted) in a manner to diminish that edge.

The necessity to maintain a qualitative edge on the battlefield is one consideration, but how about the commercial concern involved in developing these technologies? The commercial significance must also be taken into consideration, and it is the balancing of the twin objectives of protecting the nation's security and promoting global economic development that is most challenging. It is along the "fault lines" of national security, promoting global economic development, and foreign policy that possible dichotomies exist in some of our national policies.

We are attempting, through international agreements and export laws, to preclude the spread of technology associated with the spread of weapons of mass destruction and their delivery systems. While the success of these international agreements and export laws can be debated, one must look at whether there should be another national policy approach towards controlling critical technologies.

This new approach must take into consideration the changes in technology from the Cold War era. We must take a more integrated perspective of protecting critical emerging technologies, and move beyond our attack on the "supply side" equation of proliferation. An integrated approach will best

meet the demands of an ever-increasing competitive global marketplace and minimize the threat from adversaries.

In this paper, I discuss the Defense Department's dual-use technology program, very briefly the critical emerging technologies for Army-After-Next (AAN), current national strategy to protect our competitive edge via export controls, and finally recommended changes to our national strategy to promote national security, global economic development and trade.

BACKGROUND

Our national security strategy is enunciated in the Administration's annually published National Security Strategy (NSS). One of the primary tenets of the recent NSS is our ability to shape the international environment with an assortment of foreign policy tools (diplomacy, international assistance, arms control, nonproliferation initiatives and military activities). In shaping the international environment, the NSS recognizes the need to protect critical technologies associated with the spread of weapons of mass destruction (WMD) and their delivery systems.[2] We have clearly evolved from a strategy of containment in the Cold War to one of denial. We are trying to deny rogue states both WMD and the technology to advance their delivery systems. But what of the technology

with commercial application that can actually improve the standard of living in foreign countries, and of the commercial goods produced in this country to meet those demands? The NSS also discusses promoting prosperity, enhancing American competitiveness, and export control reform.[3] These concepts ("control" and "promoting trade") create an inherent antagonistic relationship both within the Administration, and between Congress and the Executive branch. There are two separate control systems which have evolved into what can be considered as policy schizophrenia. Due to the international concern with the spread of conventional weapons, dual-use technology and WMD, several international agreements and arrangements have been established (e.g., Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, Missile Technology Control Regime, Australia Group, Nuclear Suppliers Group, and Biological and Chemical Weapons Conventions). U.S. export control policies are linked to these arrangements.

The Defense Department's entrée into the international control regimes can be tied to the Military Critical Technologies List (MCTL), published by the Undersecretary of Defense for Acquisition and Technology. Among other things, it provides the technical justification for multinational export

control activities.[4] The MCTL will be discussed more in a later chapter.

In addition to the international arrangements mentioned above, we must consider the export control systems that are governed in the U.S. by different laws and enforced separately by the Departments of Commerce and State. These will be discussed in much more detail in a subsequent chapter, which will look at them from a historical perspective, programmatic approach, successes/failures, and the interagency process.

So what are the linkages we are looking for? We are looking for linkages between the Defense Department's ability to identify, document and develop critical emerging technologies, and the strategic policies to control them.

What becomes apparent is the significance of competing interests and multitude of stakeholders. These include national security specialists, corporations interested in increasing market share, Congressional oversight by a multitude of committees/subcommittees, and foreign policy considerations.

I believe a dual-use technology and production strategy will allow the Department to leverage the overall U.S. industrial base and keep our weapon systems on the leading edge of technology - the winning edge.

— Paul G. Kaminski
Under Secretary of Defense for
Acquisition and Technology

DUAL-USE TECHNOLOGY - A DEFENSE STRATEGY

For years, the defense industry had been the catalyst for developing emerging technologies of military importance that were subsequently found to have significant commercial application. However, with the decline in defense research and development dollars, the preponderance of current and future technologies will in all likelihood be developed within a consortium of defense/commercial industries (dual-use technologies), or singularly by private industry.

These technologies, developed in partnership with private industry will then be infused as is (commercial-off-the-shelf) or modified for military weapons application (technology insertion).

Although defense research, development and acquisition stimulated some of the most significant technological innovations in this century (e.g., semiconductor, computer and aircraft industries), the rapid growth of certain high technology industries (driven by commercial markets), has

reduced the role of defense spending as a driving force for innovation.[5]

The Defense Department's strategy is summarized in a February 1995 document, entitled *Dual-use Technology: A Defense Strategy for Affordable, Leading Edge Technology.*

The goals of the dual-use technology program are to **invest research and development dollars into dual-use technologies, dual produce** (integrate military requirements into commercial production) and **insert commercial capabilities into military systems.**

Acquisition reform is critical to this entire process. The product development cycle times, driven by demands in the private sector, are far outpacing the Defense Department's in-house "flash-to-bang" time. As such, we are much more reliant on leveraging private sector capability in delivering leading-edge, next-generation technology. This requires us to be ever vigilant in defining defense requirements early for development modifications to products and technology that have a strong commercial demand and military application.

INVEST RESEARCH AND DEVELOPMENT DOLLARS INTO DUAL-USE TECHNOLOGIES

As a result of the reduction in defense-sponsored research and development, there is a critical concern with maintaining a

viable commercial industrial base capable of producing leading edge military technology. Many specialized commercial concerns involved exclusively with defense systems development have gone out of business. Dual-use programs can be utilized to protect critical industrial base capability in this country by partnering defense and commercial industries in the development of leading edge dual-use technology.

The Defense Department has developed a Dual-Use Science and Technology Program, which seeks to identify companies developing commercial technologies that could be used in an array of military applications. Congress has established goals for these projects based on a percentage of military services' applied research budgets ($115M in FY99). Inducements to industry are cost-sharing, access to government technology and military markets, and modified contracting procedures outside of the normal acquisition regulations.[6] In a meeting to be held in Chicago, IL on 25 Mar 99, the government is expecting several hundred participants to attend and hopefully seek participation in eight areas of technology:

- affordable sensors
- advanced propulsion, power, and fuel efficiency
- information and communication systems
- medical and bioengineering technologies

- weapon systems sustainment
- distributed mission training
- advanced materials and manufacturing
- environmental technologies

There are several success stories to date of the dual use/partnering with industry concept:

- advances in semiconductor development (lithographic technology - wafer processing and increased chip functionality)
- flat panel displays
- microelectromechanical systems (merges information processing and communication with sensing and actuation[7]
- advanced composites for aircraft
- integrated high performance turbine engine technology
- rotorcraft technology (DOD established the National Rotorcraft Technology Center in 1996 to partner with private industry)
- automotive technology (DOD established the National Automotive Center in 1993 to partner with leaders in the auto industry and research automotive technology to transfer to/from defense/private industry)
- high density storage systems

- wireless communications

DUAL PRODUCE

The concept of dual producing is being pursued as a means of combining military and commercial production, thus spreading fixed infrastructure costs over a larger population.

Much of the success of dual production and the dual-use technology program have been the recognition that technologies and manufacturing process do overlap in the military and private sector. There are several success stories involving transitioning defense-sponsored technologies to commercial application and developing/deploying new manufacturing technologies:

- Military GPS receivers in Desert Shield cost $34K, while the commercial receiver cost $1.3K. Military GPS receivers today are procured using commercial standards at a cost of $1.2k each
- Microwave monolithic integrated circuits (MIMIC) receive, transmit and process millimeter microwave signals, and are the eyes and ears for our radar(s) and "smart" munitions. MIMICs initially cost $8K each, with the F22 fighter employing 2,000 per aircraft for its radar. DOD is now working with private industry in incorporating this technology in collision avoidance systems of vehicles,

satellite communications, etc. To date, the price per MIMIC has been reduced to $2K each

- Precision lasering machines is a military developed laser technology that has been shared, through a consortium, with machine shops and manufacturing plants across the United States

INSERT COMMERCIAL CAPABILITIES INTO MILITARY SYSTEMS

Wherever possible, the Defense Department should make use of readily available commercial products, components and technologies for insertion into military systems. The Defense Department should consider simple modification of MILSPEC requirements, without sacrificing combat effectiveness, to allow for the introduction of commercially available, lower cost items. Preferably, defense requirements can be identified in the early stages of design and development and can be built into the commercial production of commercial items. These imbedded capabilities, designed to meet military requirements, may not raise the production costs that much, and will most assuredly be cheaper than producing a military version of a commercial product.

The Defense Department's reliance on private industry will only increase in the future. This partnership will continue to develop critical technologies and allow U.S. forces to have

access to these critical emerging technologies that have both a military and commercial application. Let us not forget that private industry's interest in developing these technologies is to be able to commercially exploit them in the open marketplace. While no one should question their patriotism, we must understand that their constituents are shareholders concerned with profitability, market share and future corporate earnings.

What the defense industry must be concerned with is how the technologies, once on the open market, can be used for offensive and defensive purposes. Vigilance by the intelligence community and materiel developers is critical. It is important to understand that the U.S. does not have the market cornered on emerging technologies. Many are being developed overseas in consortiums, research centers and universities. While the Defense Department has very little influence over the private research centers and universities in this country, it has none in foreign countries.

As we make greater use of commercial technologies in defense systems, there are significant strategic policy considerations that will come into play - export controls, protection of intellectual property, defining "what" must be protected (technical data, end products, components), foreign investment in commercial-military consortiums, etc.

These questions and policy considerations will grow as the "blurring" of the military-commercial application spectrum continues.

History has given us the choice; science has given us the chance; love of country gives us the duty - to reach out to the future and pull it towards us.

— William S. Cohen
Secretary of Defense

CRITICAL EMERGING TECHNOLOGIES FOR ARMY-AFTER-NEXT

The Army's vision of the future is evolving through the Army-After-Next (AAN) process that is managed by the U.S. Army Training and Doctrine Command (TRADOC). Resident within the Deputy Chief of Staff for Doctrine, the AAN office is conducting broad studies of future warfare out to around 2020 for the purpose of defining concepts and ideas that are vital to the Army. AAN studies follow along four azimuths, one being the evaluation of evolving technologies and systems concepts, along with the planning of the science and technology investments necessary to support the Army on the future battlefield.[8]

The AAN process uses notional concepts from multiple sources (government and private sector), and evaluates them to assess their military application. These concepts are further evaluated for optimization by changes to force structure. In addition, teams comprised of members of military labs, academia, and private industry analyze the concepts for feasibility and affordability. Those concepts approved by TRADOC are exercised in subsequent wargames.

AAN technological insights are developed through a network of technologists from government, academia and private industry. To ensure linkage with the combat development process and science and technology funding streams, the AAN office has established close ties with the Office of the Secretary of the Army (Research, Development and Acquisition), Defense Advanced Research Projects Agency (DARPA), and the TRADOC combat development community.

Within AAN, a strong science and technology investment strategy has begun to evolve. A new AAN Science and Technology Objective (STO) enhancement program has been budgeted for FY99. In addition, TRADOC is looking at realigning basic and applied research accounts to obtain increased focus on critical technologies that must be matured in order to enable the AAN. The intent of this realignment is to double the applied research accounts that focus on AAN priorities.

There are a number of players involved in the development of AAN technologies. Some key players within the U. S. Army are Army Materiel Command, Army Research Institute for Behavioral and Social Sciences, Medical Research and Materiel Command, Space and Missile Command and Army Research Lab (ARL). Outside Army, the AAN office maintains working relationships with DARPA, universities, scientific forums, federally funded research and development centers, and other government laboratories.

One of the key players at the Defense level for identifying critical emerging technologies is the Defense Threat Reduction Agency (DTRA). DTRA develops and publishes the Military Critical Technologies List (MCTL), with Volume III dedicated to developing critical technologies. This document is a detailed, structured compendium of the technologies the Defense Department assesses as critical to maintaining superior U.S. military capabilities.[9] "Critical technologies" is defined in the MCTL, Volume III as those which, "when fully developed and incorporated in a military system, will produce increasingly superior performance or maintain a superior capability more affordably."[10] The MCTL is developed in consort with members of other government agencies, industry, and academia, and is comprised of 20 technical working groups (sensors, materials, lasers and optics, space systems, directed and kinetic energy systems, etc.) with over 1,000 people. Theoretically, these are the critical technologies that are either being researched today, or will need to be in order to field technologically advanced weapon systems which, along with realistic training, will allow U.S. forces to continue to enjoy superior capability in the 21st century.

So what are the critical emerging technologies essential to enabling the AAN? In the AAN Annual Report to the Chief of Staff, Army, the AAN office lists its AAN Technology Long List.[11] This list is actually a compendium of systems, capabilities, and technologies that the Army feels are critical to enabling the full spectrum dominating force of the future.

In essence, the technology enablers upon which AAN will be dependent are:

- Advanced Materiels
- Hybrid/alternate power sources
- Ultra-reliable systems with embedded diagnostics/prognostics, integrated into distribution networks
- Biomedical/biochemical engineering advances
- Advanced signature control, deception and identification
- Integrated sensors (air/ground/space) with sense-discriminate-analyze-report capability
- Assured C4ISR
- Unmanned systems, some with advanced fire support capability
- Knowledgeable, precision munitions

If we look today at where the advances are being made in the above technologies, we would find a broad range of laboratories, universities, research consortiums, etc. It would be hard to find any of these technologies being researched and developed exclusively within a defense setting, and perhaps more alarming, exclusively in this country. Israel is excelling in aerospace, sensor and missile research and development, European countries in remote sensing satellites and Japan in production equipment (semi-conductors and machine tools).[12] The national security concerns of these countries are not always in consonance with our own.

So what should be the defense community's concern with these emerging technologies? If they are so critical to our armed forces maintaining technological superiority on the future battlefield, what controls are in place to ensure their application by others will not be used to denigrate our capabilities.

DTRA (Science and Technology Division) represents the Defense Department in tying emerging technologies (with military application) into international control mechanisms. It also works with the Departments of State and Commerce in getting some unilateral controls over U.S. developed technologies. There is a strong correlation (i.e., similarity) between the AAN identified technology enablers and the emerging technologies on the MCTL.

It is imperative that the AAN office maintain a collaborative relationship with DTRA, either directly or through a conduit such as ARL. This is important for two reasons. First, we must maintain visibility over critical emerging technologies in the private sector and outside of the U.S. As identified in the previous section, the technology development cycle is much faster in private industry and we must be able to react in a fashion to get those critical technologies into our funding streams. Second, if the technology is critical enough to us AND can be a source of a threat or future threat to us (militarily), DTRA can initiate the process to get it into the international/national export control forums. As we have discussed in our own U.S. Army War College AAN class, we must anticipate that those technologies which have wonderful life-improving effects (e.g., biotechnology), also have the potential to be used for sinister purposes by an adversary.[13]

The allegation that a major U.S. satellite manufacturer provided China with sensitive technologies that may have applicability to its missile programs has highlighted how the United States controls the export of such technology and how this policy has changed in recent years.

— Kathy V. Schinasi
GAO, testimony before the Select Committee on Intelligence, U.S. Senate

PROTECTING OUR COMPETITIVE EDGE - EXPORT CONTROLS

There are two distinctive export control systems in place that are driven by fundamentally different premises, and as such, have different regulations and a different ethos in viewing the application of export controls. The State Department is governed by the Arms Export Control Act, and utilizes export controls to further foreign policy and national security. The Commerce Department, governed by the Export Administration Act, while concerned with national security and foreign policy, is also charged with, and gives significant weight to, economic and trade interests of the United States.

The current strategic export control programs have their origins rooted in the Cold War era and were intended to prevent the Soviets and Warsaw Pact from obtaining and incorporating Western technology into their weapon systems programs.[14] The U.S. intelligence community determined that the Soviets'

technology acquisition efforts (espionage, open-source information, illegal trade diversions and smuggling) were extensive in the 1970's and 1980's.[15] The leakage of technology to the Soviets were referred to by former Defense Secretary Weinberger as "technological hemorrhaging" and that "virtually every Soviet military project had benefited from acquired Western technology...that the West was subsidizing the Soviet buildup."[16] The Soviets' success in developing a significant military capability, based on Western technology, was documented in September 1985, in a Department of Defense White paper entitled *Soviet Acquisition of Militarily Significant Western Technology: An Update.* It listed 21 critical areas that the Soviets were able to compress the development cycle time of weapon advances by acquiring Western technology, reverse engineering where possible, and incorporating it in their weapon systems. Successful Soviet advances due to illegally acquired Western technology include look down/shoot down radar, air-to-air missiles, semi-conductor development, submarine propulsion, MIG 29, and SU-25/27 fighter capabilities.

One of the earliest international forums to address the control of technology flow from Western nations to the Soviet Union and the Warsaw Pact was the Coordinating Committee for Multilateral Export Controls (COCOM), established in 1949. COCOM maintained 3 lists to track and implement the export

control regime (International Munitions List, International Atomic Energy List, and the International List of Dual-use Items). Decisions to approve members export requests or to change the lists required unanimous approval, and served the United States interests in maintaining strict conformance with export controls. The United States also passed the 1949 Export Control Act and the 1951 Battle Act, which illustrated the U.S. conviction that trade is a legitimate instrument of national security.[17]

The Clinton administration, in all practicality, is following the Bush administration in its liberalization of export controls. The most significant policy changes have involved dual-use technology. With the termination of the Cold War, export licensing applications are down annually from approximately 100K to around 10K, our supercomputer policy has been liberalized (driven by technology advances), and we have seen U.S. satellite launches in China.[18]

COMMERCE DEPARTMENT PERSPECTIVE

The Export Administration Act of 1979 gave the Department of Commerce the authority to regulate the flow of dual-use technology. The act restricts the export of goods and technology which would make a significant contribution to the military potential of any other country, and which would prove

detrimental to the national security of the United States.[19] The crux of the debate that continues today is what constitutes "a significant contribution to the military potential of any other country." As would be expected, the Commerce Department interprets the threat of technology much different than the Departments of Defense and State.

Dual-use technology items are identified in the Commerce Department's Commodity Control List (CCL). Despite being on this "control list," only about 10% of trade associated with these items require an export license. Whether a dual-use technology item requires an export license is dependent upon the item and its destination. While this has reduced the administrative burden of obtaining licenses and sped up overseas sales of dual-use items to non-threatening nations, we enter a whole other realm of re-export requirements and national discretion of trade of other countries that exacerbates the potential for proliferation of these items. The desire for commercial industry to retain items on the CCL as opposed to the State Department's U.S. Munitions List (USML) is because Congressional approval is not required for dual-use technology items on the CCL.

The challenge that faces this country today is that most of the international agreements previously mentioned are not binding treaties, but arrangements. As such, other countries

see the threat (or lack thereof) of readily available technology much differently than we do in the U.S. and are prone to export technology and conduct trade in a matter that is in their own national interest. Unlike the COCOM agreement, which required unanimous approval for the export of a controlled item, "national discretion" is the rule of engagement used by nations under the Wassenaar Arrangement to determine what can be exported. The added danger of this new arrangement is that, unlike the COCOM agreement, there is no pre-notification requirement of license approvals of controlled items being shipped. This minimizes influence or dialogue with other signatories to address their concerns with the export of these controlled items. In a recent case as told to me by a high ranking Commerce Department official engaged in export control policy, the Japanese sold the Chinese a semi-conductor processing plant for $2.3B. Their decision took four days while we were wringing our hands over what to do about the requested purchase and the national security implications. Our export control policies, because they are interwoven with national security and foreign policy considerations, are confusing to our allies.

The Commerce Department process in reviewing items for export involves five agencies - Departments of Commerce, State, Defense, Energy, and the Arms Control and Disarmament Agency.

Disagreements are elevated to the Operating Committee (an interagency working group), chaired by a Commerce Official, and a majority decision, along with Commerce approval, results in approval for export. Appeals can be made to an Advisory Committee on Export Policy (sub-cabinet level), then to the cabinet-level Export Administration Review Board, and then to the President.

The economic loss due to export controls is difficult to measure. There is a paucity of government and industry statistics, although glaring incidents such as the recent $2.3B Japanese sale of a semi-conductor facility to China stands out. The 1987 National Academy of Sciences Report, *Balancing the National Interest*, concluded that in 1985, inflexible controls caused a loss of $7.3B in export sales, a $17.1B loss in gross national product, and a loss of over 188,000 jobs.[20] We can assume that the figure is significantly higher today. The further debilitating occurrence and one of significant concern is the effect this has on our technological industrial base. Sales lost to foreign competitors incur lost reinvestment opportunity costs - resources our industries do not have in further developing emerging technology. This fact is not lost on the Defense Department, which as mentioned earlier, has several programs partnering itself with commercial industry in the development of emerging critical technologies. While it is

an opportunity to leverage capability, reduce operating costs and shorten "flash-to-bang" time on product development, a second order effect is a strong, viable U.S. technology base that remains in the forefront in the 21st century.

STATE DEPARTMENT PERSPECTIVE

The State Department's involvement in export control is governed by the Arms Export Control Act and the International Traffic in Arms Regulations (ITAR), which give State the authority to control the export of arms and related technologies. Unlike Departments of Commerce and Defense, State Department has both a trade and national security mission. In general, however, State Department is much more cautious in its approach to export controls, and tends to weigh national security more.

The State Department maintains the U.S. Munitions List (USML) as part of the ITAR, which focuses primarily on weapons systems and related technologies, but also includes some dual-use items (e.g., jet engines, night vision equipment) that are also controlled (albeit with different parameters) on the CCL. The State Department has broad authority in denying export authority to items on the USML, and generally involves only the Defense Department in its review. Industry interest in whose control list an item is on is driven in part by the timeline for

licensing approval. The approval timeline for the CCL is 90 days, while there is no time limit for approving items on the MCL. Also, as mentioned earlier, items on the CCL do not require Congressional approval.

There are several recent highly publicized cases that bring to light the concerns with export control policy, and the differences in the processes at State and Commerce. The most recent was the missile technology information exchange with Hughes Electronics/Loral Space and Communications and the Chinese government, which was thought to have provided the Chinese with critical technology that could improve their ballistic missile program. The decision to move responsibility for licensing communications satellites and jet engine hot section technology (both dual-use items) to Commerce's CCL in 1995 was made to facilitate U.S. commercial exports and to bring U.S. licensing practices regarding these technologies into line with those of other Western countries.

In testimony before the U.S. Senate Select Committee on Intelligence regarding issues related to the communications satellite sales to China, GAO addressed the following reasons why Commerce procedures are less stringent than State:

- Congressional notification requirements no longer apply under Commerce

- Sanctions do not always apply to items under Commerce's jurisdiction
- Defense's power to influence the decision-making process has diminished
- Technical information may not be as clearly controlled under the Commerce system[21]

In my discussion with both the Departments of Commerce and State, the general sentiment was that the interagency process is broken. There have been several Executive Orders to address the process, but there appears to be no clear vision from the Executive Office, and until recently, this appeared to be a low priority at the National Security Council.

FUTURE CHALLENGES

The imposition of strategic export controls will be even more complex in the years ahead because of emerging trends and forces. Emerging technologies are being developed around the world. Adversaries have an increasingly broader market to obtain critical technologies, material and expertise. A crucial challenge to the United States is to persuade other countries that the possession of critical technologies also brings with it obligations and responsibilities.[22] Another challenge will be the rise of transnational corporations, which will look to promulgate technology (even that developed in the United States)

throughout their global markets in order to increase their competitiveness. Economic consortiums (similar to the European Union (EU)) will continue to emerge and the United States will be faced with continuous economic pressure. Further, export licensing across member states (e.g., EU) diminishes our ability to enforce or influence re-exporting of technology further embedded in end items.

Several factors need to be considered in determining whether our export control policies are sufficient to protect critical emerging technology with military application. At face value, the processes today appear to be cumbersome with some duplication of effort. On the MCTL alone, there are several hundred technologies/processes. I would imagine the CCL is just as cumbersome. There are 13 Congressional committees and subcommittees that are involved in the business of export control policy. The licensing process, while shortened under the current administration, still is exhaustive and costly to government and private industry alike. Through interviews with the Departments of Commerce, State and Defense, and reading numerous congressional testimonies on this topic from both government and private industry, I am convinced this system needs some adjustment. Following are factors that need to be considered in finding our way ahead in the export control arena:

- Technology has changed from hardware, end items and components to technical information, manufacturing know-how and intellectual property
- Emergence of non-nation states and the international community's ability to deny them access to critical technology
- Technical denial will delay, not prevent access
- Increased difficulty of reverse engineering due to miniaturization and sophistication of chip based technologies[23]
- Dynamic western technology development will in all likelihood outpace an adversary's ability to successfully integrate previous technology into weapon systems (i.e., technology becoming second generation in a compressed amount of time)

The innovations in weapons technology will affect America's defense strategies on land and sea, in air and space, reshaping our military forces, while confronting us with new strategic challenges as America enters the next century as the dominant power on the globe.

— George and Meredith Friedman
The Future of War

THE WAY AHEAD

The importance of our ability to maintain a qualitative edge on the future battlefield cannot be stressed enough. The concern with the current threat of proliferation of weapons of mass destruction highlights the threat to our national interests. This threat can only intensify as technology is proliferated throughout the world. It should be apparent that our ability to "control" technology is fairly limited. Technology dimensions have changed, it is being developed in partnership with commercial industry, and research and development is being conducted on critical technologies around the world. There are many vested interests (Congress, commercial industry, Departments of State, Commerce, and Defense), mostly with competing and conflicting views, in how dual-use technology should be controlled. However, with the growing concern with proliferation of weapons of mass destruction (control) and the rise of emerging global economic competition (trade), our

current system and organizations need to evolve to accommodate a changing world environment.

A broad policy guideline for export controls, weaving together foreign policy, national security, and economic interests in the context of evolving global international political and economic evolution is lacking.[24] Does this mean that we should scrap our current export controls policy? As a minimum, through collaborative efforts with our allies and signatories to the international control agreements, and some of the recommended changes below, I believe we can strengthen the world's ability to contain the proliferation of militarily critical technologies.

Following are recommendations I feel will strengthen our controls on emerging critical technologies, while at the same time promote trade and economic development:

(A) Several organizational changes are needed to strengthen our export control policy. The National Security Council (NSC) once had a senior advisor on export control policy with a small staff, but the function merged with the Nonproliferation Directorate with a single staff individual responsible for export control. The focus of this directorate is now on weapons of mass destruction, and focus on critical emerging technologies (outside of weapon system delivery capability) languishes. The NSC should provide more staff analytical capability of export

control policy and its relationship to foreign policy, national security policy and economic development.

Despite how blasphemous it might sound, serious consideration should be given to centralizing export control policy authority to a single agency. There are two export control systems in place with an antagonistic relationship built into the process. Technologies move back and forth across both control lists and Congress arbitrarily moves items from one to another because of the "Washington Post" affect. Most recently, Congress transferred the authority for satellite exports from the Department of Commerce to the Department of State, effective March 1999. It is doubtful we could ever have a single system because of the international agreements and what could or could not be put on an integrated single list. The checks and balances built into the current process are confusing to industry, confusing to our allies, and confusing to implementers of the policy on items that are "at the margin" on both control lists. Modifications to existing law that would allow a single executive department to maintain both control lists, along with a much stronger interagency process, would move us closer to a coherent, integrated approach to export control policy. Further, the approval timeline should be the same for items on both lists to meet commercial demands and exploit trade opportunities.

B) There should be a concerted effort to review the control lists on a routine basis, with emphasis to reduce the number of items on both. This must be done in consonance with a concerted effort to reduce the items on the international arrangements. There are several hundred items on each list, and while items are constantly added, few are taken off. This is frustrating to industry and our allies, and results in their willingness to trade some items that they do not see as threatening to their national security.

C) We need to present to our allies and trade partners a credible and coherent argument what our national security concerns are for dual-use technology items we preclude from trade. Perhaps a better understanding of our national security concerns will provide them better insight into why we attempt to influence their decision to trade the same items, and therefore mitigate their decision to trade dual-use technology items that they did not initially recognize as "threatening" from a more global perspective.

D) Our enforcement focus should be targeted to those items or technologies specifically associated with weapons of mass destruction. This should be done in a methodical way. In other words, obtaining a widget alone does not make an adversary a threat. We have to consider their ability to adapt it and incorporate it into a delivery system. In this example, rather

than going after banning sale of all widgets, which may raise the standard of living in certain countries, maybe we should focus on the "delivery systems." This is perhaps a simplistic view of the problem, but rather than protect everything, we should focus on critical components or technology that would actually give an adversary a "clunky Hiroshima-class weapon."[25] Specific control efforts should also be targeted at those critical technologies we excel at (e.g., sensors, stealth, propulsion, infrared, imagery enhancement, etc).

E) Our current export control policies are targeted at the "supply side" of emerging technologies. I believe a complementary policy approach dealing with the "demand side" is warranted, especially as it pertains to China. There is a significant amount of anxiety towards China, one that permeated the discussions I had with senior policy officials with Departments of State, Commerce and Defense. China, the champion of the non-aligned states during the Cold War, was excluded in the formation of any of the international arrangements and a signatory to none. We have taken positive steps in bringing China into the family of nations, and we have made progress on national security/trade issues (e.g., China signed the Nuclear Non-Proliferation Treaty, cutoff nuclear export to unsafe facilities, and we allowed commercial satellites to be launched there). However, I believe we can make a better effort of

incorporating China into the international control regimes. China presents many political challenges to us today, and will only become a more dominant player on the world scene next century. They present a vast market whose demands WILL be met in the future - by us or someone else. The political and economic opportunities cannot be ignored. Further, the Chinese recognize Hong Kong as being a portal to the west from both a trade perspective and access to emerging technology. A senior export control policy official at Department of State lauded the success of Hong Kong's export control policy, and saw little change under Beijing. Both China and the west should use this "portal" as a conduit to continue trade of dual-use technology and a model (export control policy) to incorporate on the Chinese mainland to ensure continued access to emerging technology.

China recognizes the United States as the leader in emerging dual-use technologies, and seeks to obtain them legally or illegally. I believe that we have an excellent opportunity today to engage China in the international export control process. Specifically, we should:

- Identify overlapping areas of common interest so that China can internalize the implications of WMD proliferation

- Bring China into the discussions early on in formulating international agreements - specifically, a new regime structure to control the emerging forms of technology transfer is warranted, and China should be a key player in its development
- Structural differences from our own exist in China, so that the Peoples Liberation Army operates autonomous from other ministries and the defense industry. High level exchanges between industry and uniform personnel should be conducted to understand the needs of China's military and the direction their defense industries are headed. Partnering with Chinese defense industries in meeting China's social demands would open up economic markets and allow for the flow/control of desired U.S. technology
- Tie U.S. technology access to Chinese actions.[26] There are critical items the Chinese seek (supercomputers, machine tools, etc.) for which the U.S. is the recognized leader. However, these items are becoming evermore available from other sources, though of a lesser quality. While we should not rely on technology access as a key policy element, we should take advantage of the time that we have as the preeminent technology leader in certain areas to influence China's actions in areas of importance to us

(i.e., export control, re-export, end item verification, etc.)

- Hong Kong has one of the better export control systems in the world.[27] Based on the successes of the Hong Kong model (export controls and open market economy), we should encourage China to utilize facets of it throughout China

As we can see, our ability to control militarily significant emerging technologies is a daunting task that poses many challenges - today and in the future. There are clear linkages between the technologies the Army is trying to develop in its Army-After-Next Project and the mechanism to have some of them placed on international control regimes. We can expect that this will become more challenging as we rely on commercial development of many of these technologies. It is important that we understand that the face of technology itself is evolving (from items to information), and that export control policies and international control regimes must reflect these changes.

A more comprehensive U.S. export control strategy is needed, one that addresses both the supply side of technology proliferation and the demand side. An integrated export control approach will attenuate our concerns of maintaining a technologically superior military in the future. The world today has an "appetite" for U.S. technology, and while the U.S.

remains a leader in this field, we should leverage our superiority in shaping the world of the future.

WORD COUNT = 6,915

ENDNOTES

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[3] Ibid., 14, 15 and 17.

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[7] Kaminski, 13.

[8] Undersecretary of Defense, Acquisition and Technology,7.

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[10] Ibid.

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[17] Ibid, 5.

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[19] 50 U.S.C section 2402(2)(A) (1982).

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[22] Seward, 41.

[23] McDaniel, 175.

[24] Ibid, p. 136.

[25] Interview with a senior export policy official at the State Department

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[27] Interview with a senior export control policy official at the Department of State.

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